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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/020,314

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Yasuhiro Shimamoto

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10/31/2006

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EXAMINER

NGUYEN, KHIEM D

ART UNIT

PAPER NUMBER

2823

DATE MAILED: 10/31/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/020,314

Applicant(s)

SHIMAMOTO ET AL.

Examiner

Khiem D. Nguyen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 August 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,3-8,10-16 and 18-32 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,3-8,10-16 and 18-32 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 18 December 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on August 09th, 2006 has been entered. A new rejection is made as set forth in this Office Action. Claim (1, 3-8, 10-16, 18-20, and 21-32) are pending in the application.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

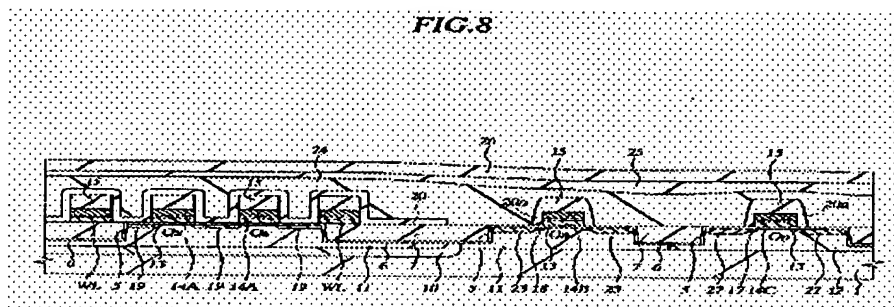
3. Claims 1, 3, 8, 10-16, 18, 20-22, and 28-31 are rejected under 35 U.S.C. 102(e) as being anticipated by Sugawara et al. (U.S. Patent 6,544,834).

In re claim 1, Sugawara discloses a fabricating method of a semiconductor integrated circuit device comprising forming a bottom electrode **54** of a capacitor with high-k material on a semiconductor substrate **1** by a chemical vapor deposition method in

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a sub-atmospheric pressure using an organoruthenium compound as a precursor (col. 17, lines 6-18), which includes steps of:

- (a) providing the semiconductor substrate 1 in a deposition chamber;
- (b) after the step (a) increasing a temperature of the semiconductor substrate 1 in the chamber up to a desired temperature without supplying any oxidation gas to the deposition chamber (col. 12, lines 5-21 and FIG. 8);



In re claim 8, as applied to claim 1 above, Sugawara discloses all claimed limitations including the limitation wherein the supplying step further comprising a step of controlling the amount of oxygen adsorption onto the surface of the semiconductor substrate 1 by the amount of a supplied vaporized solvent gas (col. 17, line 65 to col. 18, line 16).

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In re claim 10, as applied to claim 1 above, Sugawara discloses all claimed limitations including the limitation wherein the organoruthenium compound comprises at least one of

bis-(cyclopentadienyl)ruthenium $[\text{Ru}(\text{C}_5\text{H}_5)_2]$,
bis-(methylcyclopentadienyl)ruthenium $[\text{Ru}(\text{CH}_3\text{C}_5\text{H}_4)_2]$,
bis-(ethylcyclopentadienyl)ruthenium $[\text{Ru}(\text{C}_2\text{H}_5\text{C}_5\text{H}_4)_2]$,
tris-(dipivaloylmethanate)ruthenium $[\text{Ru}(\text{C}_{11}\text{H}_{19}\text{O}_2)_3]$, and $\text{Ru}(\text{OD})_3$.

(col. 17, lines 6-18).

In re claim 11, as applied to claim 1 above, Sugawara discloses all claimed limitations including the limitation wherein the solvent for dissolving the organoruthenium compound to comprises at least one of methanol, ethanol, 1-propanol, 2-propanol, isobutyl alcohol, 1-butanol, 2-butanol, diethyl ether, diisopropyl ether, octane, tetrahydropuran, tetrahydropyran, 1,4-dioxane, acetone, methyl ethyl ketone, and toluene (col. 17, lines 6-18).

In re claim 12, as applied to claim 1 above, Sugawara discloses all claimed limitations including the limitation wherein the method further comprising: after forming the bottom electrode 54, immediately performing annealing at not less than a formation temperature of the bottom electrode made of ruthenium in a reducing atmosphere containing hydrogen thereby removing oxygen introduced into a surface of the ruthenium metal film when the ruthenium metal film is formed therefrom and inhibiting deformation of crystal grains of the bottom electrode of ruthenium in the annealing step during or after forming a high-k capacitor insulator (col. 17, lines 42-61).

In re claim 13, as applied to claim 12 above, Sugawara discloses all claimed limitations including the limitation wherein the annealing temperature in reducing atmosphere is not more than the annealing temperature for crystallization of the capacitor insulator (col. 17, lines 42-48).

In re claim 14, as applied to claim 12 above, Sugawara discloses all claimed limitations including the limitation wherein the temperature at which the deformation of crystal grains of the bottom electrode 54 of ruthenium is inhibited is 800 °C or less (col. 17, lines 42-49).

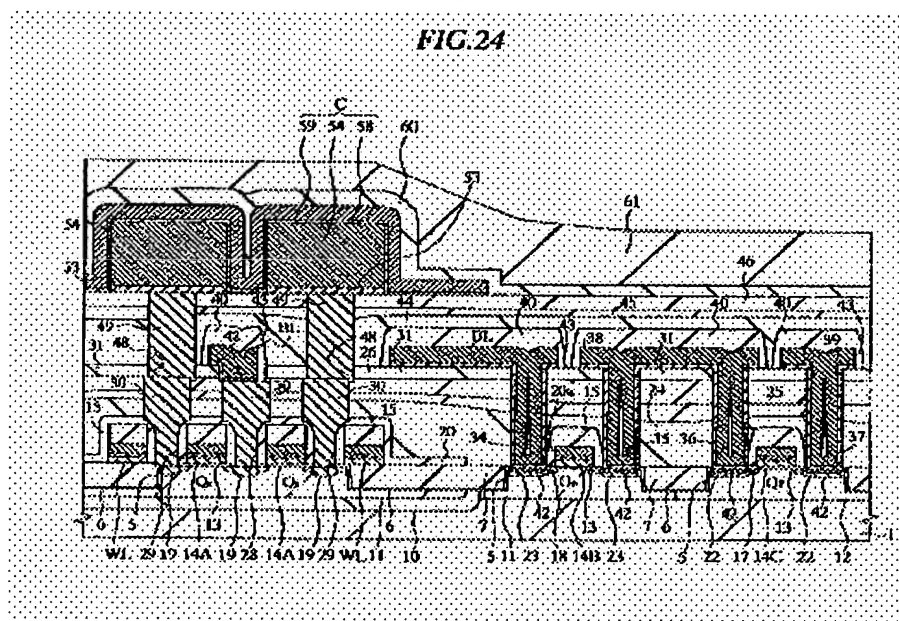
In re claim 15, as applied to claim 12 above, Sugawara discloses all claimed limitations including the limitation wherein a grain size of the crystal grains of the bottom electrode of ruthenium ranges from 30 nm to 60 nm (col. 16, lines 32-45).

In re claim 16, as applied to claim 1 above, Sugawara discloses all claimed limitations including the limitation wherein the electrode of ruthenium of a capacitor with high-k material is formed on the semiconductor substrate, and immediately thereafter annealing is performed at not less than the formation temperature of the bottom electrode of ruthenium in an inert atmosphere or a reducing atmosphere thereby inhibiting deformation of crystal grains of the bottom electrode of ruthenium in the annealing step during or after capacitor insulator formation (col. 17, lines 42-61).

In re claim 18, as applied to claim 1 above, Sugawara discloses all claimed limitations including the limitation wherein the oxidation gas comprises at least one of O₂, N₂O, H₂O, NO₂, and O₃ (col. 15, lines 44-49).

In re claim 20, as applied to claim 12 above, Sugawara discloses all claimed limitations including the limitation whereby the annealing step is performed at a temperature lower than a crystallization temperature of the high-k capacitor (col. 17, lines 42-49).

In re claim 21, Sugawara discloses a fabricating method of a semiconductor integrated circuit device comprising forming a top electrode 59 (col. 20, lines 3-5) of a capacitor with high-k material on a semiconductor substrate 110 by a chemical vapor deposition method in a sub-atmospheric pressure using an organoruthenium compound as a precursor (col. 17, lines 6-18 and FIG. 24), which includes steps of:



- (a) providing the semiconductor substrate 1 in a deposition chamber;
- (b) after the step (a), increasing a temperature of the semiconductor substrate 1 in the chamber up to a desired temperature with supplying an oxidation gas to the deposition chamber (col. 12, lines 5-21 and FIG. 8);

FIG. 20 is a cross-sectional view of a multi-layered structure. It shows a top layer (52) with a diagonal hatching pattern, a middle layer (54) with a stippled pattern, and a bottom layer (56) with a cross-hatching pattern. The structure is divided into several vertical sections by vertical lines. The leftmost section is labeled 51. The middle section is labeled 53. The rightmost section is labeled 55. The structure is supported by a base (57) with a cross-hatching pattern. The base is divided into several vertical sections by vertical lines. The leftmost section is labeled 58. The middle section is labeled 59. The rightmost section is labeled 60. The structure is also labeled with various other reference numerals: 31, 48, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100.

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In re claim 22, as applied to claim 21 above, Sugawara discloses all claimed limitations including the limitation wherein the ruthenium electrode 59 forming method further includes a step of introducing a balance gas in addition to a carrier gas (Ar) so as to keep a pressure in the deposition chamber constant through all of the other steps (col. 16, lines 46-55).

In re claim 28, as applied to claim 21 above, Sugawara discloses all claimed limitations including the limitation wherein the supplying step further comprising a step of controlling the amount of oxygen adsorption onto the surface of the semiconductor substrate 1 by the amount of a supplied vaporized solvent gas (col. 17, line 65 to col. 18, line 16).

In re claim 29, as applied to claim 21 above, Sugawara discloses all claimed limitations including the limitation wherein the organoruthenium compound comprises at least one of

bis-(cyclopentadienyl)ruthenium $[\text{Ru}(\text{C}_5\text{H}_5)_2]$,
bis-(methylcyclopentadienyl)ruthenium $[\text{Ru}(\text{CH}_3\text{C}_5\text{H}_4)_2]$,
bis-(ethylcyclopentadienyl)ruthenium $[\text{Ru}(\text{C}_2\text{H}_5\text{C}_5\text{H}_4)_2]$,
tris-(dipivaloylmethanate)ruthenium $[\text{Ru}(\text{C}_{11}\text{H}_{19}\text{O}_2)_3]$, and $\text{Ru}(\text{OD})_3$.

(col. 17, lines 6-18).

In re claim 30, as applied to claim 21 above, Sugawara discloses all claimed limitations including the limitation wherein the solvent for dissolving the organoruthenium compound to comprises at least one of methanol, ethanol, 1-propanol, 2-propanol, isobutyl alcohol, 1-butanol, 2-butanol, diethyl ether, diisopropyl ether,

octane, tetrahydropuran, tetrahydropyran, 1,4-dioxane, acetone, methyl ethyl ketone, and toluene (col. 17, lines 6-18).

In re claim 31, as applied to claim 21 above, Sugawara discloses all claimed limitations including the limitation wherein the oxidation gas comprises at least one of O₂, N₂O, H₂O, NO₂, and O₃ (col. 15, lines 44-49).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 4-7, 19, 23-27, and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sugawara et al. (U.S. Patent 6,544,834).

In re claims 4-7, as applied to claim 1 Paragraph 3 above, Sugawara discloses all the claimed limitations including during the supplying step, the oxidation gas, an inert gas, and a solvent gas are supplied such that a oxygen partial pressure created by the oxidation gas in the deposition chamber such that an amount of oxygen adsorption onto a surface of the semiconductor substrate is set to a minimum amount required for decomposing the precursor thereby increasing the mount of oxygen adsorption onto the surface of the semiconductor substrate 1 and shortening a growth time of the electrode (col. 15, lines 22-27) but does not explicitly teach or suggest that oxygen partial pressure created by the oxidation gas in the deposition chamber is 0.1 Torr or less and 0.5 Torr or less.

However, there is no evidence indicating the oxygen partial pressure ranges created by the oxidation gas in the deposition chamber is critical and it has been held that it is not inventive to discover the optimum or workable oxygen partial pressure ranges of a result-effective variable within given prior art conditions by routine experimentation. See MPEP § 2144.05.

Note that the specification contains no disclosure of either the critical nature of the claimed dimensions of any unexpected results arising there from. Where patentability is aid to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

In re claim 19, as applied to claim 4 above, Sugawara discloses all claimed limitations including the limitation wherein the inert gas comprises at least one of argon (Ar) (col. 16, lines 46-55).

In re claims 23-27, as applied to claim 21 Paragraph 3 above, Sugawara discloses all the claimed limitations including during the supplying step, the oxidation gas, an inert gas, and a solvent gas are supplied such that a oxygen partial pressure created by the oxidation gas in the deposition chamber such that an amount of oxygen adsorption onto a surface of the semiconductor substrate is set to a minimum amount required for decomposing the precursor thereby increasing the mount of oxygen adsorption onto the surface of the semiconductor substrate 1 and shortening a growth time of the electrode (col. 15, lines 22-27) but does not explicitly teach or suggest that oxygen partial pressure

created by the oxidation gas in the deposition chamber is 0.1 Torr or less and 0.5 Torr or less.

However, there is no evidence indicating the oxygen partial pressure ranges created by the oxidation gas in the deposition chamber is critical and it has been held that it is not inventive to discover the optimum or workable oxygen partial pressure ranges of a result-effective variable within given prior art conditions by routine experimentation. See MPEP § 2144.05.

Note that the specification contains no disclosure of either the critical nature of the claimed dimensions of any unexpected results arising there from. Where patentability is aid to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

In re claim 32, as applied to claim 23 above, Sugawara discloses all claimed limitations including the limitation wherein the inert gas comprises at least one of argon (Ar) (col. 16, lines 46-55).

Response to Applicants' Amendment and Arguments

6. Applicants' arguments with respect to claims 1, 3-8, 10-16 and 18-32 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Khiem D. Nguyen whose telephone number is (571) 272-1865. The examiner can normally be reached on Monday-Friday (8:30 AM - 5:30 PM).

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew S. Smith can be reached on (571) 272-1907. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

K.N.
October 27, 2006

Brook Kebede
BROOK KEBEDE
PRIMARY EXAMINER